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Reference: Year 3 Final Annual Report for the San Diego Thornmint Expansion Project
(SANDAG Grant Number 5004957; RECON Number 8378)

Dear Ms. Morrissey:

Executive Summary

The primary goal of the San Diego Thornmint Expansion Project (project) was to improve and expand areas occupied by the San Diego thornmint (*Acanthomintha ilicifolia*) through restoration and enhancement of degraded habitat within Mission Trails Regional Park (MTRP) Fortuna. San Diego thornmint is included in the San Diego Management and Monitoring Program (SDMMP) Management Strategic Plan (MSP) as a Category SO (Significant occurrence(s) at risk of loss from the Management Strategic Planning Area). This program addresses the immediate needs of thornmint within MTRP by building on the previous City of San Diego (City) weed treatment effort (based on San Diego Association of Governments-funded Conservation Biology Institute (CBI) protocols to control purple falsebrome (*Brachypodium distachyon*) and to address loss and degradation of existing thornmint habitat due to an increase of invasive plants and drought. Activities included in this program consisted of herbicide treatment, thornmint seed collection, seed bulking and redistribution, vegetation monitoring, photo monitoring, and thornmint monitoring. City of San Diego rangers and Natural Resources department staff dedicated several hours of City staff time to support the success of the Thornmint Project.

This project is consistent with the management objectives and actions prescribed in CBI's/ SDMMP's Adaptive Management Framework for the Endangered San Diego Thornmint, the MTRP Natural Resources Management Plan, and the City of San Diego Multi-Habitat Planning Area-Eastern Area Multiple Species Conservation Program (MSCP) Subarea Plan.

The goals of this project include:

- Improve and expand areas occupied by the San Diego thornmint.
- Control purple falsebrome to address loss and degradation of existing thornmint habitat due to an increase of invasive plants and drought.

Year 3 project results include an increase in the number of thornmint and area occupied by thornmint compared to the baseline conditions. At the time of the Year 1 baseline survey (May 2018), 43 thornmint plants were observed in the fenced natural population. No additional thornmint plants were observed outside of the fenced natural population area. During the Year 2 thornmint survey (May 2019), a total of 318 San Diego thornmint individuals were observed to be in the fenced natural population, 21 plants were observed in seeded Plot 1 and 34 plants were observed in Plot 2 for total of 374 plants representing an increase of 330 plants over the Year 1 results.

In Year 3 (May 2020), the final year of this project, a total of 326 San Diego thornmint individuals were observed to be in the fenced natural population, 80 were observed in seeded Plot 1 and 85 were observed in Plot 2. 355 thornmint plants were observed outside of the fenced areas where additional seeding occurred on November 18, 2019. The total number of thornmint observed in 2020, including the natural population and seeded areas was 846, which represents an increase of 803 plants over the baseline condition in 2018.

The project has been successful at increasing the number of individuals as well as significantly increasing the area occupied by the plants. A comparison of the area occupied by thornmint prior to implementation and the area of thornmint after the seeding program was implemented indicates that the area occupied increased significantly.

Originally the natural population occupied approximately 273 square feet. At the end of the three-year restoration and seeding program, the area occupied by thornmint increased to approximately 4,087 square feet. This represented an increase of approximately 3,814 square feet of occupied thornmint area. Non-native cover has decreased during the implementation of this three-year project. In September 2017, prior to implementation of weed control activities, the baseline cover survey estimated that non-native cover was 12.1 percent. At the end of Year 3, the non-native cover was estimated to be 2.1 percent, a decrease of 10 percent over the baseline conditions.

1.0 Introduction/Project Background

This Year 3 Final Annual Report provides background information and summarizes the tasks performed during the three-year project (July 21, 2017 to June 30, 2020) located at MTRP. Three quarterly reports for Year 3 were prepared and submitted by RECON. Information from those reports is summarized below.

The target area for restoration and enhancement is located within the western portion of MTRP (Figures 1–3; see Attachment 1 for all figures and Year 3 photographs and Attachment 3 for repeat photographs). Overall, the MTRP currently contains over 7,000 acres of preserve land established to create an open space system that will protect natural resources and provide a series of interconnected viable habitats to protect MSCP covered species and regional wildlife corridors.

2.0 San Diego Thornmint Status and Conservation

San Diego thornmint is federally listed threatened, state listed endangered, and considered a narrow endemic species under the City MSCP Subarea Plan (City of San Diego 1997). It also has a California Native Plant Society (CNPS) rare plant ranking of 1B.1 (rare, threatened, or endangered in California and elsewhere; seriously endangered in California; CNPS 2019). Populations of San Diego thornmint are substantially declining throughout San Diego County. Extant populations are threatened by pressures from urban development, habitat disturbance, and invasion of non-native species, with as many as one-third of historical occurrences believed to be extirpated (CNPS 2019). San Diego thornmint is restricted to clay lens microhabitats, which limits the establishment of new populations due to the lack of such habitat remaining in San Diego (Reiser 2001).

3.0 Project Goals

Project goals are listed below:

- Improve and expand areas occupied by the San Diego thornmint (MSP Category SO [San Diego SDMMP and The Nature Conservancy 2017]) within MTRP Fortuna through restoration and enhancement of degraded habitat.

- Control purple falsebrome to address loss and degradation of existing thornmint habitat due to an increase of invasive plants and drought.

4.0 Year 1 Implementation Tasks Summary (July 21, 2017 to June 30, 2018)

4.1 Field Assessment (Task 1)

A pre-implementation field assessment was conducted by RECON biologist JR Sundberg on September 27, 2017 prior to implementing maintenance activities. The field assessment was conducted to confirm the area best suited for restoration and enhancement. The treatment area includes approximately 0.50 acre of open areas with lower shrub cover located within friable clay soil.

After the field assessment by RECON biologists, a field meeting was arranged and attended by staff from RECON, the City MSCP, MTRP Ranger, and the Mission Trails Foundation in February 2018. The weeding strategy and access issues for the project were discussed at the meeting.

4.1.1 Vegetation Monitoring (Tasks 2 and 7)

Pre-implementation vegetation monitoring was performed using the rapid assessment method. All plant species occurring in the restoration area were recorded, and the cover of each species was estimated. The vegetation treatment area was monitored by RECON biologist JR Sundberg on September 27, 2017 prior to implementation to provide baseline conditions to compare to the site conditions at the end of the three-year restoration program. Post-implementation vegetation monitoring in Year 1 was conducted by RECON biologist JR Sundberg on May 31, 2018 to assess changes in native and non-native plant cover. The results of the vegetation monitoring efforts are presented below in Year 1 Monitoring Results Section.

4.1.2 Photo Monitoring (Tasks 3 and 8)

Photographic monitoring locations were established prior to implementation within the treatment area on September 27, 2017. The results of the pre-implementation photo monitoring are used as a visual baseline to compare to the site conditions at the end of the three-year restoration program in Section 6.4.2.

4.1.3 Focused San Diego Thornmint Survey (Task 6)

A focused San Diego thornmint Year 1 survey was conducted on May 31, 2018 by RECON biologist JR Sundberg. The focused survey for San Diego thornmint was performed to assess the distribution of thornmint within the restoration and enhancement area. The results of the thornmint monitoring efforts are presented in Section 4.3.2, Year 1 Focused San Diego Thornmint Survey Results.

4.1.4 Quarterly Reports (Task 9)

Quarterly reports that summarized ongoing tasks for the project were submitted in October 2017 (Quarterly Report I), January 2018 (Quarterly Report II), and April 2018 (Quarterly Report III).

4.1.5 Weed Control (Task 4)

In Year 1, the primary focus of maintenance activities was starting the non-native control program. Rains in January 2018 germinated non-native weeds and San Diego thornmint. Dethatching of the thornmint site occurred on March 7, 2018 and focused primarily on dried common fascicled tarplant (*Deinandra fasciculata*) that had grown very large in 2017 (Photographs 1–3). The natural population of thornmint was avoided during the dethatching and spraying. Herbicide treatment began in March 2018 and continued into April 2018 when dry conditions returned (Photographs 4–5). The RECON field crew treated non-native plant species within the restoration area with glyphosate based herbicide. Spraying was done to prevent weeds from flowering and setting seeds. Non-native species that were controlled included, purple falsebrome, tocalote (*Centaurea melitensis*), black mustard (*Brassica nigra*), and short pod mustard (*Hirschfeldia incana*). Herbicide was applied by licensed applicators under the supervision of RECON field crew director Ruth Vallejo, who is a certified Pest Control Advisor.

4.2 Year 1 2017–18 Rainfall Summary

Table 1 lists the monthly rainfall (2017-2018) that occurred at Montgomery Field, the closest reporting weather station. The early portion of the rainy season (September through December 2017) was below normal by over 3 inches. Heavier rainfall fell in January 2018 and that resulted in germination of annual weed species and San Diego thornmint; however, by late February, annual weeds had begun to desiccate due to above-average temperatures and well-below-average rainfall. Additional rains occurred in March which allowed native annuals, such as thornmint, to continue growth. These rains rejuvenated native annuals that had begun to desiccate from the dry conditions in February. The total rainfall for the 2017-18 season was below normal by over 8 inches.

Table 1
September 2017 through June 2018 Rainfall Compared to Normal Rainfall

Month	Precipitation (inches)[1]	Normal Rainfall: Precipitation (inches)[2]	Difference (inches)
2017			
September	0.11	0.26	-0.15
October	T	0.48	-0.48
November	0.02	1.17	-1.15
December	0.07	1.39	-1.32
Total	*0.20*	*3.30*	*-3.10*
2018			
January	1.94	2.52	-0.58
February	0.46	2.31	-1.85
March	1.08	2.47	-1.39
April	0.03	0.88	-0.85
May	0.06	0.28	-0.22
June	0.00	0.09	-0.09
Total	*3.57*	*8.55*	*-4.98*
GRAND TOTAL	**3.77**	**11.85**	**-8.08**

[1]SOURCE: National Oceanic and Atmospheric Administration 2018 – Montgomery Field
[2]SOURCE: Intellicast Online– Historic Averages-Montgomery Field 2018
T = Trace Amount

4.3 Year 1 Monitoring Results

4.3.1 Year 1 Vegetation Monitoring Results (Tasks 2 and 7)

Prior to implementation, a total of 14 native and 9 non-native species were recorded in the treatment area. A total of 16 native and 4 non-native species were recorded in the treatment area after implementation in spring 2018. Table 2 lists the results from the treatment area prior to dethatching and spot spraying with herbicide. Table 3 lists the results from the treatment area after the area was dethatched and spot sprayed with herbicide.

Table 2
Pre-implementation Vegetation Monitoring Results

Vegetation Type	Absolute	Relative (Vegetation only)
Average total cover (shrub & herbaceous)	65.6%	100%
Average native cover	53.5%	81.6%
Average non-native cover	12.1%	18.4%
Average native grass cover	0.0%	0.0%
Average bulb cover	0.0%	0.0%
Average shrub cover	3.5%	5.3%
Average bare ground	34.4%	N/A

Table 3
Year 1 Post Treatment—Dethatched And Sprayed Monitoring Results

Vegetation Type	Absolute	Relative (Vegetation only)
Average total cover (shrub & herbaceous)	10.1%	100%
Average native cover	8.1%	80.2%
Average non-native cover	2.0%	19.8%
Average native grass cover	0.0%	0.1%
Average bulb cover	0.0%	0.0%
Average shrub cover	8.1%	80.2%
Average bare ground	89.9%	N/A

4.3.2 Year 1 Focused San Diego Thornmint Survey Results (Task 6)

A spring 2018 survey for San Diego thornmint was conducted by RECON biologist JR Sundberg on May 31, 2018. In 2018, a total of 43 San Diego thornmint individuals were observed to be in the natural population at treatment site (Photograph 6). Not all of the thornmint that germinated successfully flowered, as some individuals dried out and died prior to flowering.

5.0 Year 2 Tasks Summary Performed From July 1, 2018 to June 30, 2019

5.1 San Diego Zoo Seed Meeting

On November 30, 2018, RECON and City biologists attended a meeting at the Beckman Center at the San Diego Zoo's Safari Park to discuss the thornmint augmentation project with the San Diego Zoo staff (Joyce Maschinski and others). At the meeting, RECON discussed their experience with previous projects involving seeding and restoring San Diego thornmint populations. At the end of the meeting, RECON was provided with 1,800 thornmint seeds that the San Diego Zoo had bulked at their growing facilities.

5.2 Vegetation Monitoring (Task 7)

Year 2 vegetation monitoring was conducted using the rapid assessment method. All plant species occurring in the treatment area were recorded, and the cover of each species was estimated. The vegetation treatment area was monitored by RECON biologist Anna Leavitt on May 6, 2019 to assess changes in native and non-native plant cover. The results of the vegetation monitoring efforts are presented in the Year 2 Vegetation Monitoring Results Section below.

5.2.1 Photo Monitoring (Task 8)

In Year 2, photographic monitoring locations were revisited within the treatment area on May 6, 2019. The results of the photo monitoring were used to compare Year 2 site conditions to baseline conditions.

5.2.2 Dispersing Thornmint Seed (Task 5)

On December 4, 2018, RECON biologists JR Sundberg and Mark Dodero prepared two caged seeding plots at the restoration site (Photograph 7). The seeded areas were fenced to minimize the chance of herbivory which had been observed at the natural thornmint population in the spring of 2018. The fenced areas were approximately 9 feet long by 3 feet wide. The wire fence was buried a few inches into the soil to discourage rodents from digging into the plots. A few cobbles were placed in the plots to allow the RECON crew to walk into the plots, if necessary, to remove weeds by hand (Photograph 8). The rocks also provided additional protection for newly germinated thornmint seedlings.

The two plots were constructed near the existing thornmint population to encourage pollinators to visit all three sites for adequate cross-pollination. RECON biologists split the 1,800 thornmint seeds bulked by the Institute for Conservation Research at the San Diego Zoo roughly in half and distributed them throughout the two plots (Photograph 9). The seeding plots were mapped with a global position system (GPS) device.

Heavy rains occurred over the next three days when over two inches of rain fell during the storm. This caused at least a portion of dispersed seed to germinate.

5.3 2018–19 Rainfall Summary

Table 4 lists the monthly rainfall (2018-19) that occurred at Montgomery Field, the closet reporting weather station. Between September 1, 2018 and June 30, 2019, rainfall at Montgomery Field was 13.50 inches, which was above normal (the average annual rainfall at Montgomery Field is approximately 11.85 inches).

Table 4
September 2018 through June 2019 Rainfall Compared to Normal Rainfall

Month	Precipitation (inches)[1]	Normal Rainfall: Precipitation (inches)[2]	Difference (inches)
2018			
September	0.00	0.26	-0.26
October	0.50	0.48	+0.02
November	1.04	1.17	-0.13
December	2.64	1.39	+1.25
Total	*4.18*	*3.30*	*+0.88*
2019			
January	1.94	2.52	-0.58
February	4.83	2.31	+2.52
March	1.09	2.47	-1.38
April	0.35	0.88	-0.53
May	1.02	0.28	+0.74
June	0.09	0.09	+0.00
Total	*9.32*	*8.55*	*+0.77*
GRAND TOTAL	**13.50**	**11.85**	**+1.65**

[1]SOURCE: National Oceanic and Atmospheric Administration 2019 – Montgomery Field
[2]SOURCE: Intellicast Online– Historic Averages-Montgomery Field 2019

The early portion of the rainy season (September through November) was below normal. Heavier rainfall fell in December 2018 that resulted in germination of annual weed species and San Diego thornmint (Photograph 10). Although rainfall in January 2019 was below normal, the well-spaced rains continued through February and early March. Later March and April were drier than normal, but above normal rainfall returned in May. The rains that occurred in the winter season allowed native annuals such as thornmint to continue growth.

5.3.1 Weed Control (Task 4)

Herbicide treatment began in January 2019 (Photographs 11 and 12). The RECON crew temporarily covered the seeded plots and natural population with tarps during spraying to prevent any overspray from affecting the thornmint. Spray treatments and hand weeding of the seeded plots continued into June 2019 when dry conditions had returned.

The RECON field crew treated non-native plant species within the restoration area with glyphosate based herbicide. Spraying was done to prevent weeds from flowering and setting seeds. Non-native species that were controlled included, purple falsebrome, tocalote, black mustard, and short pod mustard. Herbicide was applied by licensed applicators under the supervision of RECON field crew director Ruth Vallejo, who is a certified Pest Control Advisor.

5.3.2 Quarterly Reports (Task 9)

Quarterly reports that summarized ongoing tasks for the project were submitted in October 2018 (Quarterly Report I), January 2019 (Quarterly Report II), and April 2019 (Quarterly Report III).

5.4 Year 2 Monitoring Results

5.4.1 Year 2 Focused San Diego Thornmint Survey

A spring 2019 survey for San Diego thornmint was conducted by RECON biologists Mark Dodero and Anna Leavitt on May 6, 2019. In 2019, a total of 318 San Diego thornmint individuals were observed to be in the fenced natural population (Photograph 13), 21 San Diego thornmint were observed in seeded Plot 1 and 34 were observed in Plot 2 (Photographs 14 and 15). One thornmint plant was observed adjacent to Plot 1, but outside of the fencing, and 1 thornmint was observed well outside of the three fenced locations (Photograph 16; Table 5). A total of 374 thornmint were observed at the restoration site. Small-flowered morning-glory (*Convovulus simulans*), also considered to be a sensitive species by CNPS, was observed in one of the seeded plots (Photograph 17).

Table 5
San Diego Thornmint: Number of Individuals

Location	Number of Individuals
Natural Population – Fenced	318
Natural Population – Not Fenced	1
Plot 1: Seeded – Fenced*	21
Plot 2: Seeded – Fenced	34
Total Natural	*319*
Total Seeded	*55*
GRAND TOTAL	374
*One individual was observed outside, but adjacent to the fencing.	

5.4.2 Year 2 Vegetation Monitoring Results

A total of 38 native and 10 non-native species were recorded in the treatment area in spring 2019. Increasing populations of native species, were observed at the restoration site including California sun cup (*Camissoniopsis bistorta*), wedge leaved draba (*Draba cuneifolia*), Parry's phacelia (*Phacelia parryi*), and blue dicks (*Dichelostemma capitatum*). The results of the Year 2 rapid assessment surveys are discussed in further detail below. Table 6 lists the vegetation monitoring results from the treatment area that were spot sprayed with herbicide and hand weeded.

Table 6
Treatment—Sprayed

Vegetation Type	Absolute	Relative (vegetation only)
Average total cover (shrub & herbaceous)	70.4%	100%
Average native cover	68.3%	97.0%
Average non-native cover	2.1%	3.0%
Average native grass cover	0.0%	0.0%
Average bulb cover	0.0%	0.0%
Average shrub cover	8.1%	11.5%
Average bare ground	29.6%	N/A

6.0 Year 3 Tasks Summary (July 1, 2019 through June 30, 2020)

6.1 Monitoring Methods

6.1.1 Focused San Diego Thornmint Survey (Task 6)

A focused San Diego thornmint survey was conducted on May 19, 2020 by RECON biologists Anna Leavitt and Mark Dodero. The focused survey for San Diego thornmint was performed to assess the distribution of

thornmint within the restoration and enhancement area. The results of the thornmint monitoring efforts are presented in Section 6.4.1, Year 3 Focused San Diego Thornmint Survey Results.

6.1.2 Vegetation Monitoring (Task 7)

Vegetation monitoring was conducted using the rapid assessment method. All plant species occurring in the treatment area were recorded, and the cover of each species was estimated. The vegetation treatment area was monitored by RECON biologist Anna Leavitt on May 19, 2020 to assess changes in native and non-native plant cover (Photograph 18). The results of the vegetation monitoring efforts are presented in Section 6.4.3, Year 3 Vegetation Monitoring, and the plant species list is presented in Attachment 2.

6.1.3 Photo Monitoring (Task 8)

Photographic monitoring locations were revisited within the treatment area on May 19, 2020. The results of the photo monitoring are being used to compare site conditions at the start and the end of the three-year restoration program.

6.2 2019–20 Rainfall Summary

Between September 1, 2019 and June 30, 2020, rainfall at Montgomery Field (the closest reporting station) was 12.96 inches (Table 7), which was above normal by 1.11 inches (the average annual rainfall at Montgomery Field is approximately 11.85 inches).

The early portion of the rainy season (November through December) was above normal by almost 2 inches. These fall and early winter rains resulted in germination of annual weed species and San Diego thornmint. Below normal rainfall occurred in January and February 2020 and the dry conditions continued into the first week of March. Additional significant rains occurred starting March 10th which allowed native annuals such as thornmint to continue growth. These rains rejuvenated native annuals that had begun to desiccate from the dry conditions in January, February, and early March. Although it started out dry, by the end of the month, March 2020 ended up being slightly above normal. April 2020 also produced above normal rainfall for the month with a total of over 3 inches, Typically, April is the end of the rainy season with light rains, but in 2020 that was not the case.

Table 7
September 2019 through June 2020 Rainfall Compared to Normal Rainfall

Month	Precipitation (inches)[1]	Normal Rainfall: Precipitation (inches)[2]	Difference (inches)
2019			
September	0.06	0.26	-0.20
October	0.00	0.48	-0.48
November	1.92	1.17	+0.75
December	3.31	1.39	+1.92
Total	*5.29*	*3.30*	*+1.99*
2020			
January	0.34	2.52	-2.18
February	0.39	2.31	-1.92
March	2.65	2.47	+0.18
April	4.07	0.88	+3.19
May	0.01	0.28	-0.27
June	0.21	0.09	+0.12
Total	*7.67*	*8.55*	*-0.88*
GRAND TOTAL	**12.96**	**11.85**	**+1.11**

[1]SOURCE: USDC 2020
[2]SOURCE: Intellicast 2019

6.3 Maintenance

6.3.1 Thornmint Seed Dispersal

On November 18, 2019, RECON biologist Mark Dodero redistributed thornmint seed into new areas outside the fenced plots and the natural population area. After the seed was dispersed, over the next two weeks approximately 1.92 inches of rain fell. These rains likely started the germination of the thornmint seed.

6.3.2 One-time Irrigation

While the thornmint seeds had germinated in November-December 2019, weather conditions became extremely dry in January through early March. In consultation with City staff, the RECON crew was scheduled on March 3, 2020 to irrigate the thornmint one time using a water buffalo. The crew used the water buffalo to provide water to the thornmint with a hose connected to the water tank (Photograph 19). Prior to the irrigation effort, the thornmint had started to suffer herbivory and were starting to dry. The crew gave the thornmint enough water to moisten the soil which enabled the plants to persist until natural rains occurred (Photograph 20). As mentioned above, significant natural rains began to fall again on March 10 and were well spaced though the end of April which allowed the thornmint to continue growth and to flower successfully. These significant rains reduced the herbivory pressure on the thornmint.

6.3.3 Weed Control (Task 4)

As discussed previously, rains in November and December 2019 germinated weeds, fascicled tarplant, and San Diego thornmint (Photographs 21 and 22). Prior to hand weeding and spraying by the RECON crew, the project biologists flagged the locations of thornmint seedlings to enable the crew to avoid the plants while conducting weeding efforts. Hand weeding and herbicide treatment began in February 2020 and ended in April (Photograph 23 and 24). Hand weeding in the seeded plots and near thornmint outside the plots was done using hand tools to carefully clip non-natives near the soil surface to kill the roots of the weeds (Photographs 25 and 26). The RECON crew avoided the seeded plots and natural population during spraying to prevent any overspray from affecting the thornmint. The RECON crew used hand-held squirt bottles filled with herbicide near the seeded thornmint to focus the spray onto non-natives (Photograph 27). In addition to the main thornmint restoration area, the RECON crews also sprayed weeds across the road in an area that historically supported thornmint as well (Photographs 28; see Figure 4).

The RECON field crew treated non-native plant species within the restoration area with glyphosate-based herbicide. Spraying was performed to prevent weeds from flowering and setting seeds. Non-native species that were controlled included, purple falsebrome, tocalote, black mustard, and short pod mustard. Herbicide was applied by licensed applicators under the supervision of RECON field crew director Ruth Vallejo, who is a certified Pest Control Advisor.

Fascicled tarplant is abundant at the restoration site and was partially controlled because it can outcompete the thornmint. Over the long term, the project biologist recommends that the fascicled tarplant continue to be controlled to reduce its competitive advantage over the San Diego thornmint.

6.4 Monitoring Results

6.4.1 Year 3 Focused San Diego Thornmint Survey

A spring 2020 survey was conducted by RECON biologists Mark Dodero and Anna Leavitt for San Diego thornmint on May 19, 2020. The results of the thornmint survey are presented in Table 8. In 2020, a total of 326 San Diego thornmint individuals were observed to be in the fenced natural population (Photograph 29), 80 were observed in seeded Plot 1 and 85 were observed in Plot 2 (Photographs 30 and 31). Three hundred and fifty-five thornmint plants were observed outside of the fencing where the area had been seeded on November 18, 2019 (Photographs 32–34). The locations of the San Diego thornmint populations are shown on Figure 4.

A comparison of the area occupied by thornmint prior to implementation with the area of thormint after the seeding program was implemented indicates that the area occupied increased significantly. Originally the natural population occupied approximately 273 square feet. At the end of the three-year restoration and seeding program, the area occupied by thornmint increased to approximately 4,087 square feet. This represented an increase of 3,814 square feet of occupied thornmint area. Small-flowered morning-glory, considered to be a sensitive species by CNPS, was also observed growing in both seeded plots in 2020 (Photographs 35; see Figure 4).

Table 8
San Diego Thornmint: Number of Individuals

Location	Number of Individuals
Natural Population – Fenced	326
Outside of Fencing	355
Plot 1: Seeded – Fenced	80
Plot 2: Seeded – Fenced	85
Total Natural	*326*
Total Seeded	*520*
GRAND TOTAL	846

6.4.2 Photo Monitoring (Task 8)

The series of before and after photos of the site are presented in Attachment 3. The repeat photos in Attachment 3 were taken in September 2017 and again in May 2020 for comparison.

6.4.3 Year 3 Vegetation Monitoring

A total of 26 native and 15 non-native species were recorded in the treatment area in spring 2020. Increasing populations of native species, in addition to fascicled tarplant, are being observed at the restoration site each season including California sun cup, Parry's phacelia, blue dicks, and charming centaury (*Zeltnera venusta*) (Photographs 36–39). Attachment 2 lists the species observed within the treatment area. Table 9 lists the Year 3 vegetation monitoring results from the treatment area that was spot sprayed with herbicide and hand weeded.

Table 9
Treatment—Sprayed

Vegetation Type	Absolute	Relative (vegetation only)
Average total cover (shrub & herbaceous)	13.3%	100%
Average native cover	11.2%	84.2%
Average non-native cover	2.1%	15.8%
Average native grass cover	0.0%	0.0%
Average bulb cover	0.0%	0.0%
Average shrub cover	8.1%	60.9%
Average bare ground	86.7%	N/A

6.5 Previous Reporting

6.5.1 Quarterly Reports (Task 9)

Quarterly reports that summarized ongoing tasks for the project were submitted in January 2020 (Quarterly Report I), March 2020 (Quarterly Report II), and June 2020 (Quarterly Report III).

6.6 Budget and Spent Amount

For each project task listed in the grant agreement, Table 10 provides the original grant budget, the authorized rollover budget, and the amount spent.

7.0 Discussion

7.1 Weed Control

Prior to implementation (winter 2018) non-native cover was just over 12 percent. Because of maintenance efforts, weed cover in Year 3 (June 2020) was low across the thornmint site at approximately 2.1 percent within the treatment area. Spray visits and hand weeding efforts were effective at controlling weed growth. Spraying was focused around the clay lens where thornmint did not occur. Hand weeding was conducted in the areas seeded with thornmint. The area of bare ground available to be seeded with San Diego thornmint increased from 34 percent prior to implementation to 86.7 percent after treatment in Year 3. A series of before and after implementation photos are shown in Attachment 3.

7.2 San Diego Thornmint and Other Plant Growth

After the November and December 2019 rains, the San Diego thornmint germinated and began to grow. Native annuals, such as thornmint, which germinated from the fall rains began flowering earlier than is typical, in late February 2020 (Photograph 40). Herbivory of the thornmint was observed in February 2020, likely due to the very dry conditions that occurred in January through early March. After the thornmint were watered in early March and the natural rains started again, herbivory ceased. Fascicled tarplant continues to grow very large and cover a significant proportion of the restoration site. Some of the tarplant was controlled through weed whipping the previous season, and also spot sprayed and hand pulled in 2020, primarily around the seeded plots and other seeded thornmint areas. Potential thornmint pollinator observations were conducted on June 12, 2020. California bumblebees were observed making focused visits to the seeded thornmint (Photographs 41 and 42).

8.0 Recommended Future Maintenance

Recommended maintenance activities in the future, as funding becomes available, should include continued weed control through spraying of non-native annuals, such as mustards, filaree, tocalote, and grasses including purple falsebrome, using a glyphosate-based product. Long-term control of weeds and fascicled tarplant within San Diego thornmint habitat will reduce competition for resources such as light and water with the San Diego thornmint.

Another potential issue to monitor in the future is competition with native shrubs. Native shrub growth and the resulting competition with thornmint could also become an issue over the long-term. As weed species have been controlled over the last three years, native shrubs such as black sage (*Salvia mellifera*) and broom baccharis (*Baccharis sarothroides*) are starting to colonize the open thornmint areas (Photograph 43). Over time these shrub species could become significant competitors with the thornmint, eventually occupying the open areas used by the thornmint. We recommend that the growth and continued colonization by native shrubs be monitored over the long-term and control measures be taken if their growth becomes an issue.

Table 10 RECON Project Tasks: Original Budgets, Rollover Budgets, and Invoiced Amounts								
Project Task	Original Year 1 Budget	Year 1 Budget After Authorized Rollover	Original Year 2 Budget	Year 2 Budget After Authorized Rollover	Original Year 3 Budget	Original Total Project Budget	Total Project Budget After Authorized Rollover	Invoiced
Task 1: Field Assessment (Pre-implementation)	$1,527.00	$483.00	$0.00	$0.00	$0.00	$1,527.00	$483.00	$483.00
Task 2: Vegetation Monitoring (Pre-implementation)	$1,042.00	$727.50	$0.00	$0.00	$0.00	$1,042.00	$727.50	$727.50
Task 3: Photo Monitoring (Pre-implementation)	$1,746.00	$741.75	$0.00	$0.00	$0.00	$1,746.00	$741.75	$741.75
Task 4: Weed Treatment	$7,372.00	$5,183.75	$7,372.00	$14,347.00	$7,372.00	$22,116.00	$26,902.75	$25,607.50
Task 5: Seed Collection, Bulking, and Redistribution	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Task 6: Focused San Diego Thornmint Survey	$1,534.00	$295.25	$1,534.00	$1,534.00	$1,534.00	$4,602.00	$3,363.25	$3,271.25
Task 7: Vegetation Monitoring	$1,042.00	$342.50	$1,042.00	$1,042.00	$1,042.00	$3,126.00	$2,426.50	$1,829.50
Task 8: Photo Monitoring	$1,746.00	$1,260.25	$1,746.00	$1,746.00	$1,746.00	$5,238.00	$4,752.25	$4,568.00
Task 9: Quarterly Reporting	$2,020.00	$2,020.00	$2,020.00	$2,020.00	$2,020.00	$6,060.00	$6,060.00	$5,544.25
Task 10: Annual Reports	$6,896.00	$6,896.00	$6,896.00	$6,896.00	$0.00	$13,792.00	$13,792.00	$13,353.50
Task 11: Final Report (Year 3)	$0.00	$0.00	$0.00	$0.00	$9,556.00	$9,556.00	$9,556.00	$9,553.75
Task 12: Misc. Consultant Expenses	$420.00	$420.00	$270.00	$270.00	$270.00	$960.00	$960.00	$401.62
Total	$25,345.00	$18,370.00	$20,880.00	$27,855.00	$23,540.00	$69,765.00	$69,765.00	$66,081.62

If you have any questions regarding the San Diego thornmint expansion project, please do not hesitate to contact me at 619-308-9333 extension 115 or mdodero@reconenvironmental.com.

Sincerely,

Mark W. Dodero

Mark Dodero
Senior Biologist

MWD:jg

Attachments

9.0 References Cited

Brenzel, K.
2001 *Sunset Western Garden Book*. Sunset Publishing. Menlo Park, California.

California Native Plant Society (CNPS)
2019 Rare Plant Program. Inventory of Rare and Endangered Plants of California (online edition, v8-03 0.39). Website http://www.rareplants.cnps.org [accessed 09 July 2019].

Intellicast Online
2018 Historic Averages-Montgomery Field. Accessed on July 6 at http://www.intellicast.com/Local/History.aspx?location=USCA0984

2019 Historic Averages-Montgomery Field. Accessed on July 9 at http://www.intellicast.com/Local/History.aspx?location=USCA0984

Jepson Flora Project (eds.)
2020 *Jepson eFlora*, http://ucjeps.berkeley.edu/IJM.html.

National Oceanic and Atmospheric Administration (NOAA)
2018 National Weather Service Forecast Office. Montgomery Field, California. https://www.wrh.noaa.gov/sgx/obs/rtp/montgomery.html. Accessed on July 6

2019 National Weather Service Forecast Office. Montgomery Field, California. https://www.wrh.noaa.gov/sgx/obs/rtp/montgomery.html. Accessed on July 9

Rebman, J. P., and M. G. Simpson
2014 Checklist of the Vascular Plants of San Diego County, 5th edition. San Diego Natural History Museum.

Reiser, C. H.
2001 *Rare Plants of San Diego County*. Aquifir Press, Imperial Beach, CA.

San Diego, City of
1997 Multiple Species Conservation Program, City of San Diego, MSCP Subarea Plan. March.

San Diego Management and Monitoring Program
2013 Management Strategic Plan for Conserved Lands in Western San Diego County.

San Diego Management and Monitoring Program (SDMMP) and The Nature Conservancy (TNC)
2017 Management Strategic Plan for Conserved Lands in Western San Diego County: *A Strategic Habitat Conservation Roadmap*.

U.S. Department of Agriculture
2013 Plants Database. Accessed from http://plants.usda.gov.

U.S. Department of Commerce (USDC)
2020 Chronological RTP Listings by Station (May 1998 – Present). Montgomery Field Station. Accessed from https://www.wrh.noaa.gov/sgx/obs/rtp/montgomery.html.

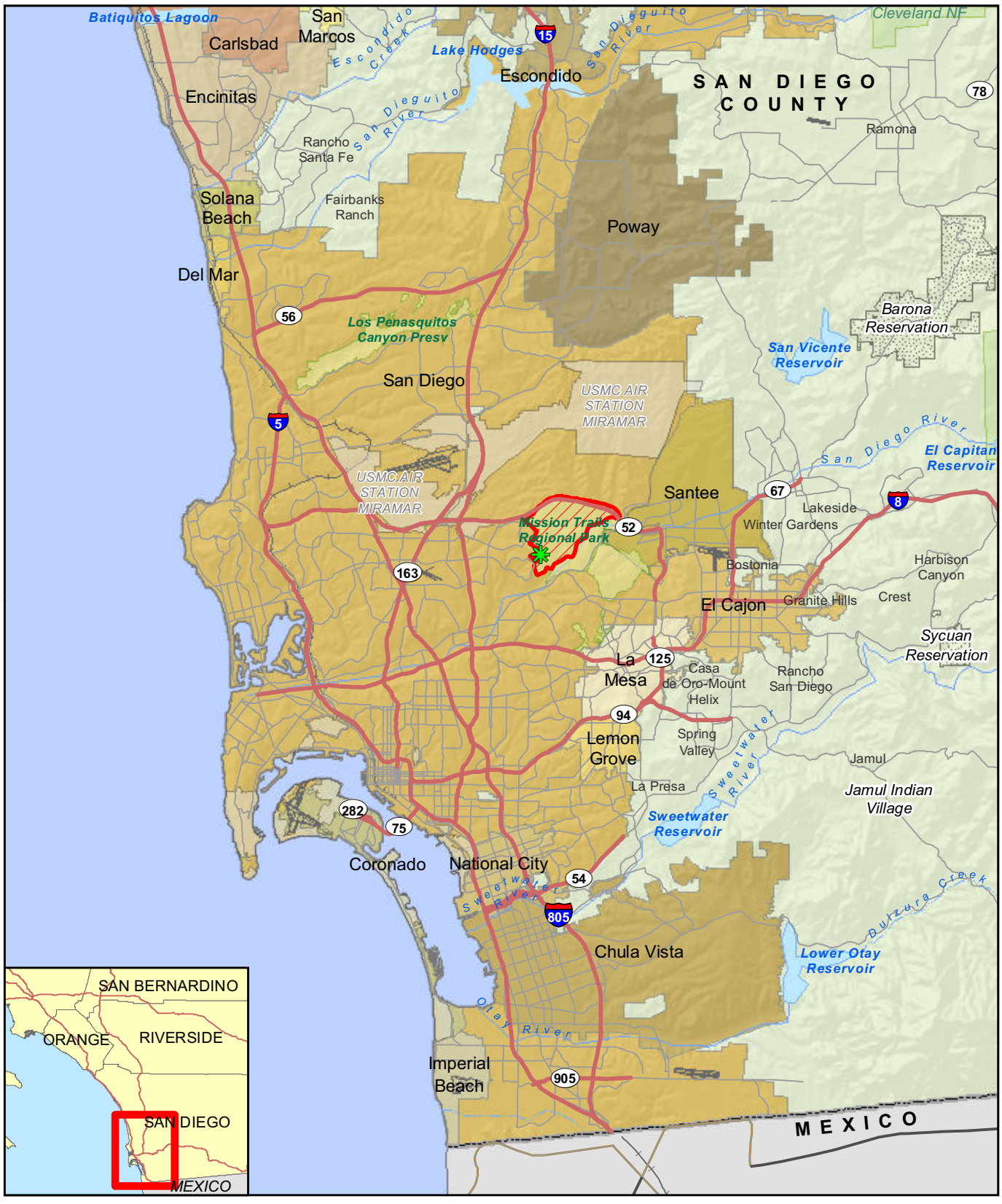
10.0 Contributors to this Report

RECON biologists that conducted field surveys, analyzed data, and provided photographs for the report include Anna Leavitt, J.R. Sundberg, and Mark Dodero.

ATTACHMENTS

ATTACHMENT 1

Figures and Photographs



Project Location

Mission Trails Regional Park – Fortuna

RECON

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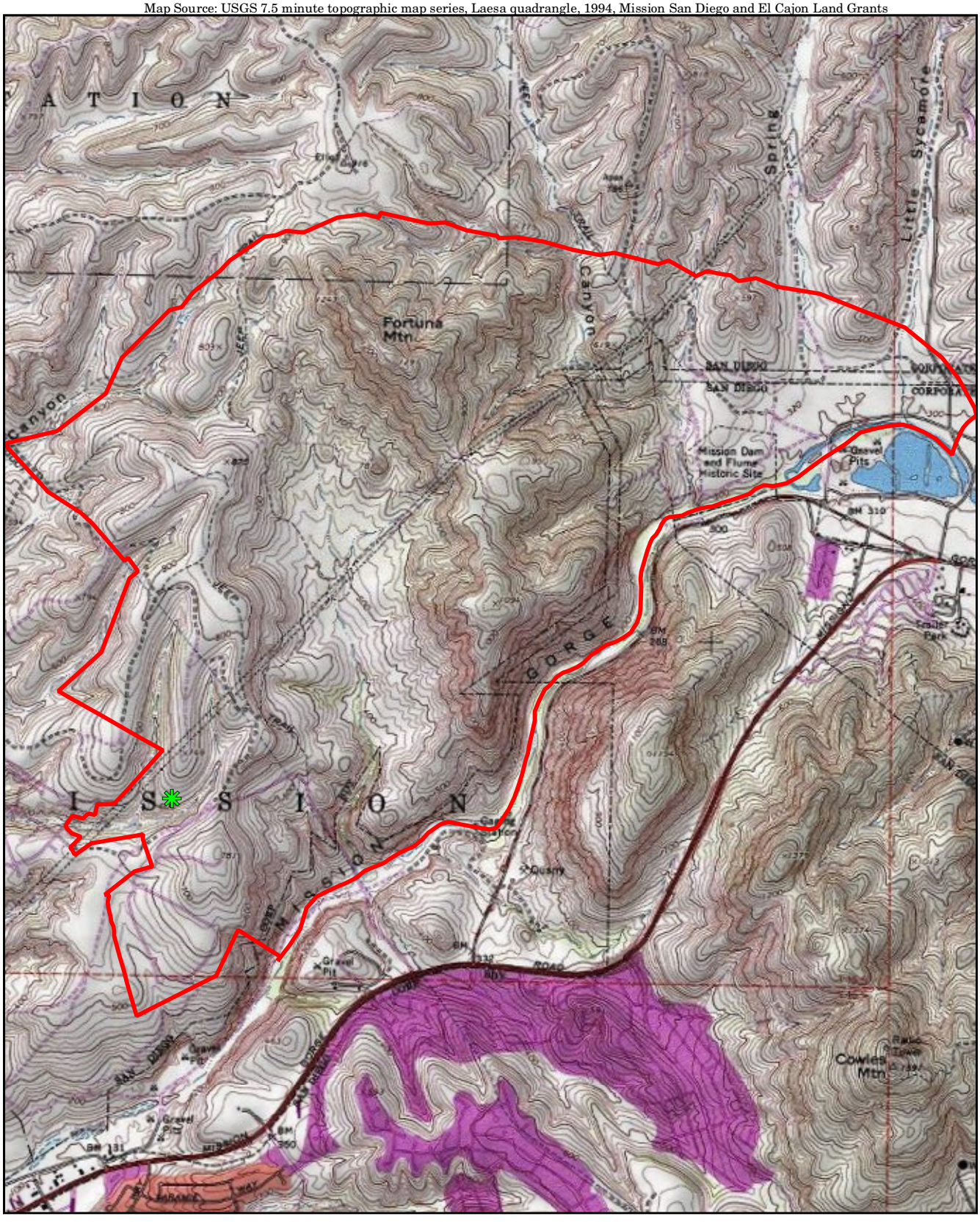
FIGURE 1

Regional Location

Map Source: USGS 7.5 minute topographic map series, Laesa quadrangle, 1994, Mission San Diego and El Cajon Land Grants



Project Location

Mission Trails Regional Park – Fortuna

RECON

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FIGURE 2

Project Location on USGS Map

Image Source: NearMap (flown May2020)

0 Feet 2,000

Project Location

Mission Trails Regional Park – Fortuna

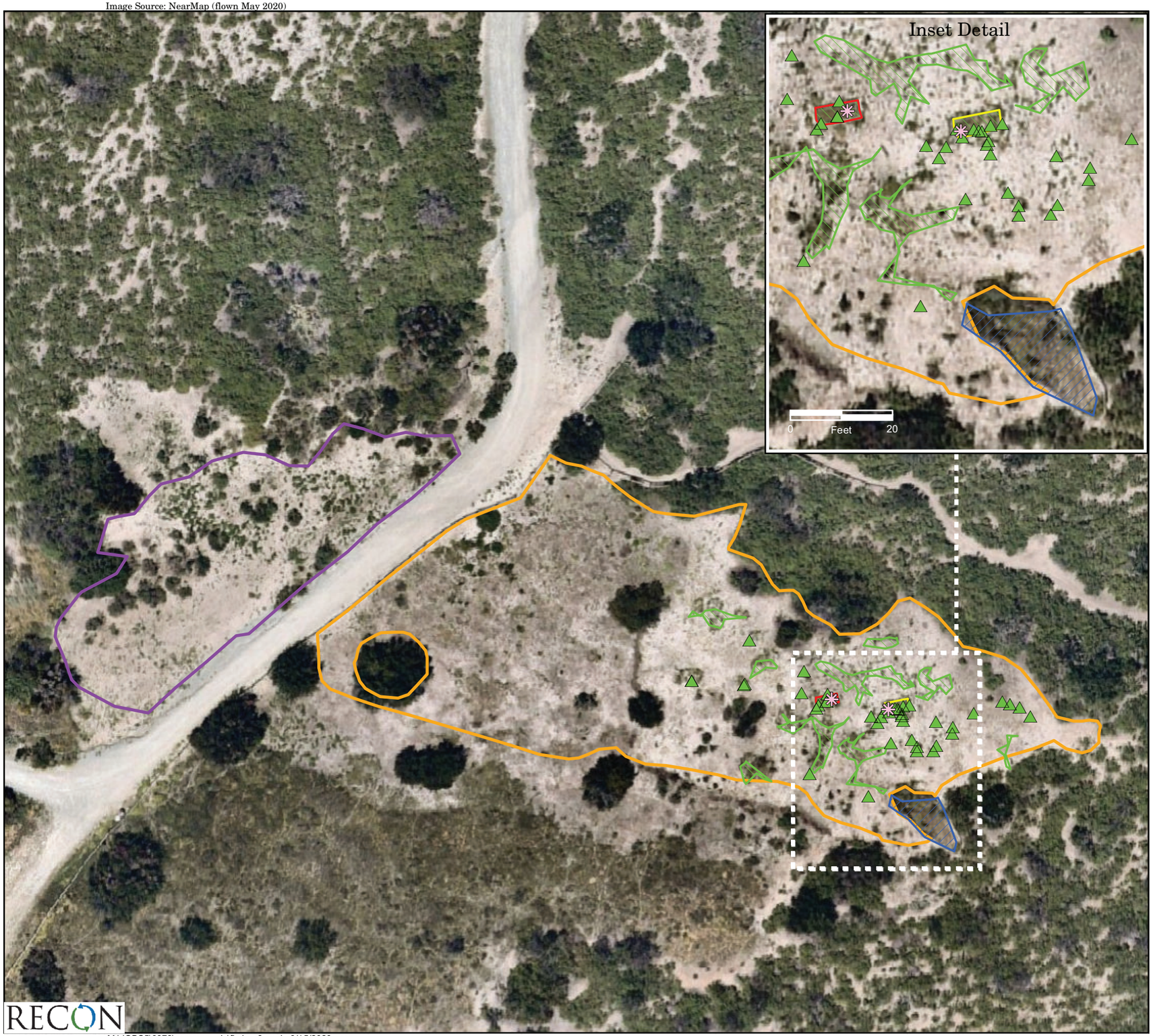
FIGURE 3

Project Location on Aerial Photograph

RECON

\\serverfs01\gis\JOBS5\8378\common_gis\fig3.mxd 8/31/2020 fmm

Image Source: NearMap (flown May 2020)



Weed Treatment Area

Additional Weed Treatment Location

Sensitive Plants

Small-flowered Morning-glory (*Convolvulus simulans*)

San Diego Thornmint (*Acanthomintha ilicifolia*)

Natural Population (Fenced)

Seeded

Plot 1 (Seeded and Fenced)

Plot 2 (Seeded and Fenced)

RECON

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FIGURE 4

San Diego Thornmint, Sensitive Plants, and Weed Treatment Locations

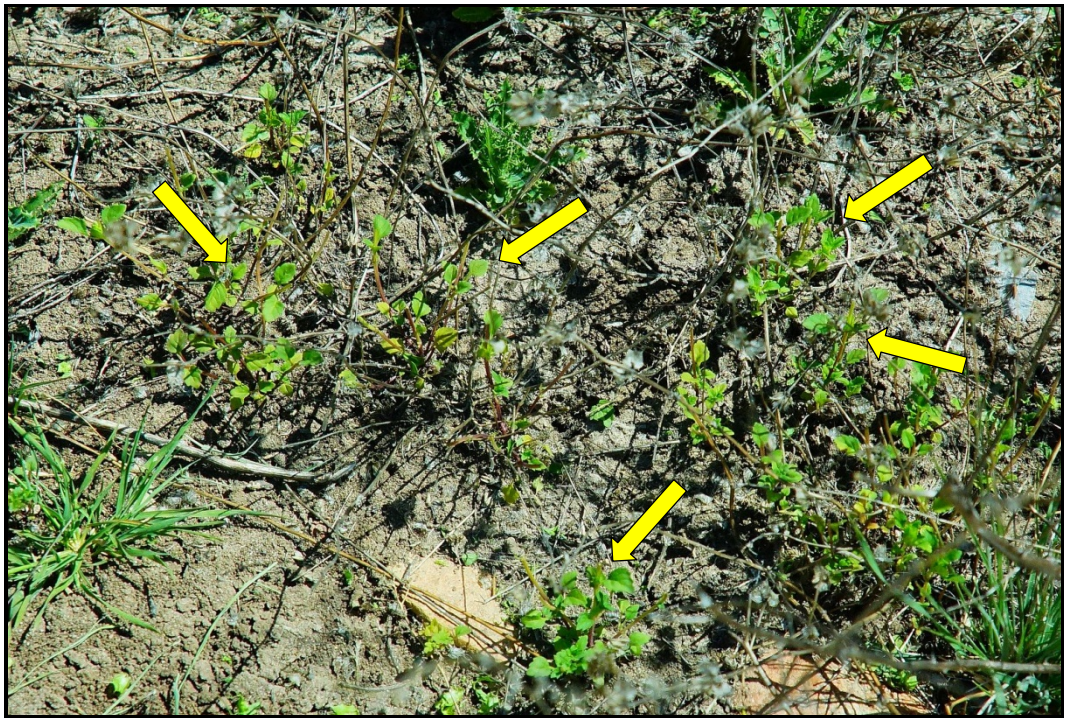
PHOTOGRAPH 1
Restoration Site Prior to Implementation Showing Fascicled Tarweed
March 2018

PHOTOGRAPH 2
RECON Crew Dethatching Dried Fascicled Tarweed
March 2018

PHOTOGRAPH 3
RECON Crew Cutting and Raking Dried Fascicled Tarweed
March 2018

PHOTOGRAPH 4
RECON Crew Spraying Non-Natives
March 2018

PHOTOGRAPH 5
RECON Crew Spraying Non-Natives
March 2018

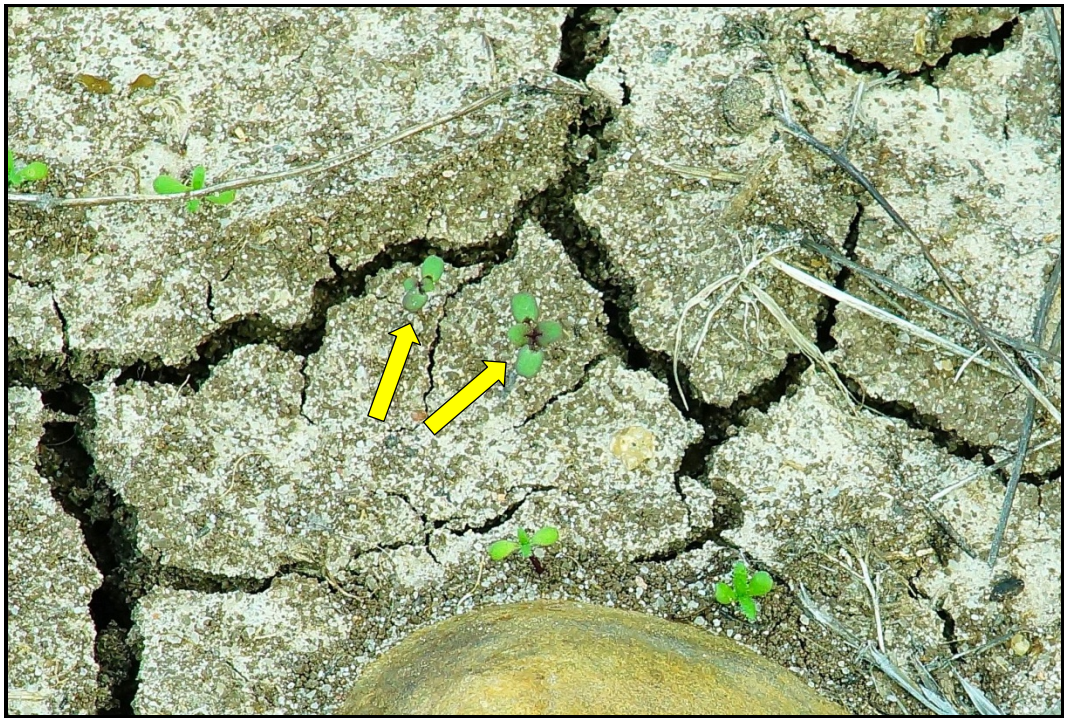


PHOTOGRAPH 6
San Diego Thornmint Growing at the Natural Population
April 2018

PHOTOGRAPH 7
RECON Biologist JR Sundberg Installing One of the
Caged Thornmint Seeding Plots
December 2018

PHOTOGRAPH 8
Caged Seeding Plot with Cobbles After Completion
December 2018

PHOTOGRAPH 9
A Portion of the Thornmint Seeds from the San Diego Zoo
December 2018



PHOTOGRAPH 10
San Diego Thornmint Seedlings at the Restoration Site
December 2018

PHOTOGRAPH 11
RECON Crew Spraying Non-Natives
January 2019

PHOTOGRAPH 12
RECON Crew Spraying Non-Natives
January 2019

PHOTOGRAPH 13
Flowering Natural Population of San Diego Thornmint
May 2019

PHOTOGRAPH 14
Flowering San Diego Thornmint in Seeded Plot 1
May 2019

PHOTOGRAPH 15
Flowering San Diego Thornmint in Seeded Plot 2
May 2019

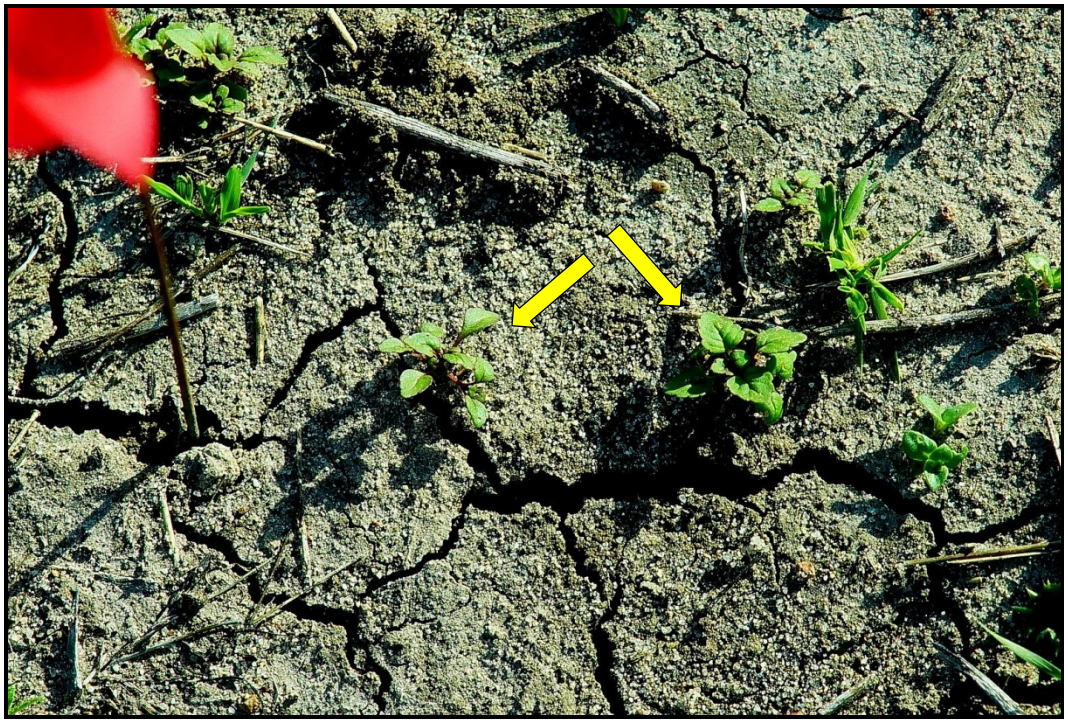
PHOTOGRAPH 16
Flowering San Diego Thornmint Outside of Fenced Plots
May 2019

PHOTOGRAPH 17
Flowering Small-flowered Morning Glory
in Seeded Plot
June 2019

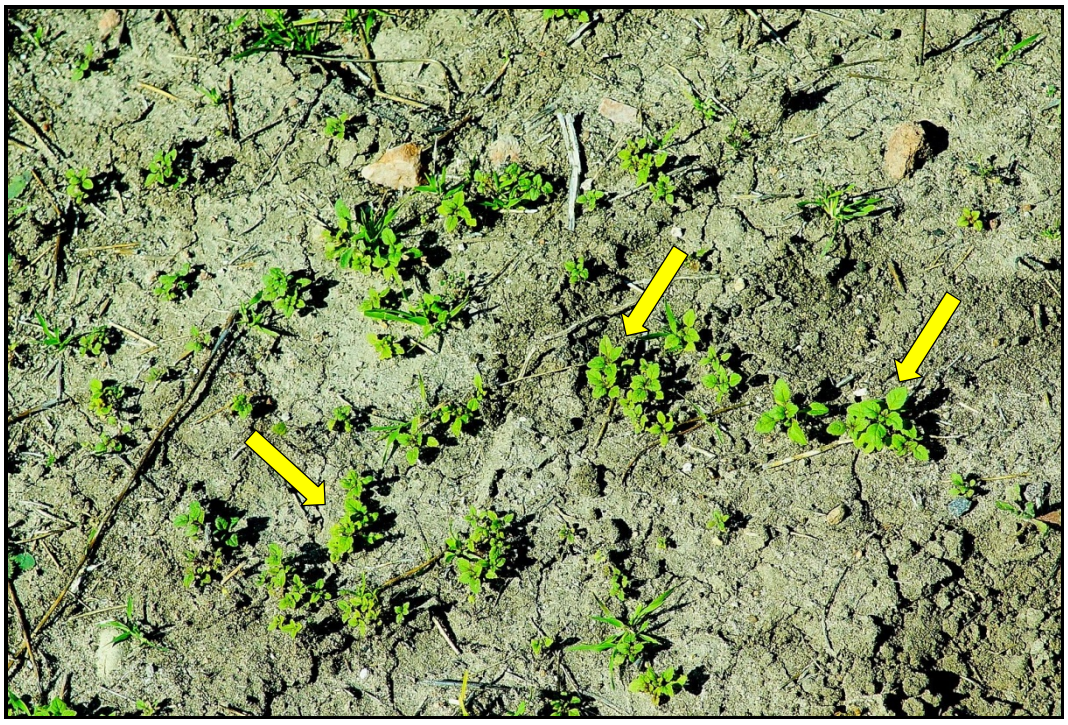
PHOTOGRAPH 18
RECON Biologist Anna Leavitt Conducting Vegetation Monitoring
May 2020

PHOTOGRAPH 19
Buffalo Water Tank Used to Temporarily Irrigate the San Diego Thornmint
March 2020

PHOTOGRAPH 20
RECON Crew Carefully Irrigating San Diego Thornmint Seedlings
after an Extended Dry Period
March 2020



PHOTOGRAPH 21
New San Diego Thornmint Seedlings Outside of Plots
January 2020



PHOTOGRAPH 22
New San Diego Thornmint Seedlings Outside of Plots
January 2020

PHOTOGRAPH 23
RECON Crew Hand Weeding a Seeded San Diego Thornmint Plot
February 2020

PHOTOGRAPH 24
RECON CREW Spraying Non-Natives
February 2020

PHOTOGRAPH 25
RECON Crew Using Hand Held Clippers to Cut Non-natives at the Base
February 2020

PHOTOGRAPH 26
Close-up of RECON Crew Using a Clipping Tool to Cut Non-natives at the Base
February 2020

PHOTOGRAPH 27
RECON Crew Using Squirt Bottles to Carefully Apply Glyphosate Herbicide
February 2020

PHOTOGRAPH 28
RECON Crew Spraying Non-natives Across the Road
from the Main Thornmint Area
February 2020

PHOTOGRAPH 29
Natural Population of San Diego Thornmint Flowering in May 2020

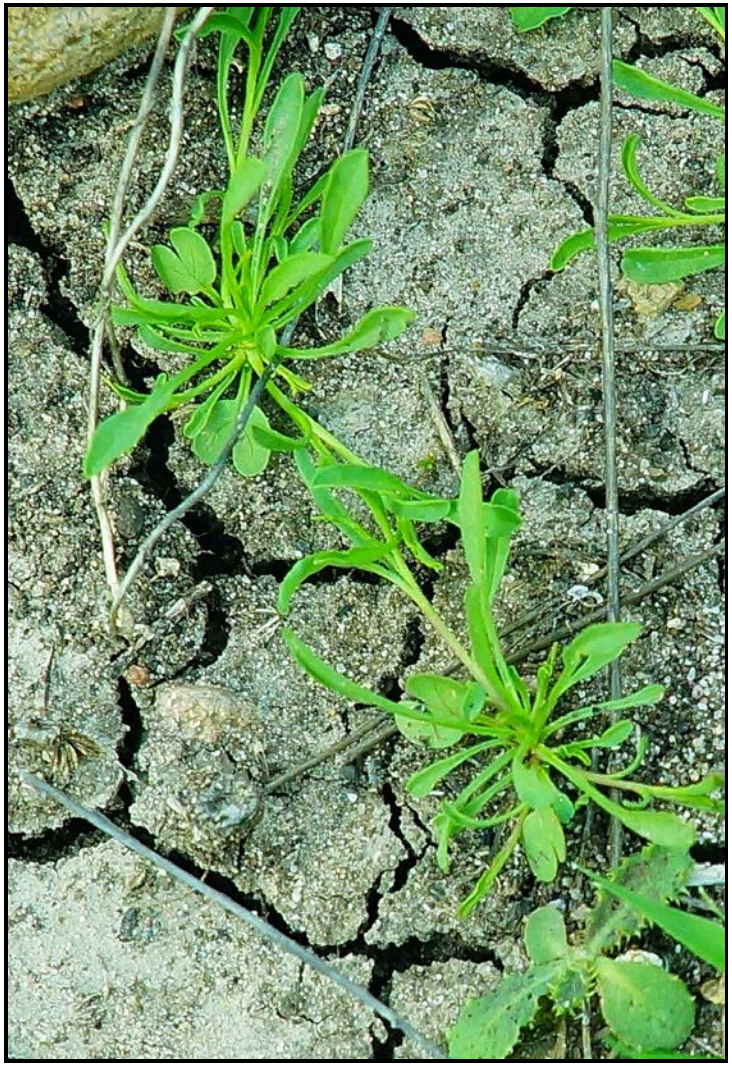
PHOTOGRAPH 30
San Diego Thornmint Flowering
in Seeded Plot 1
May 2020

PHOTOGRAPH 31
San Diego Thornmint Flowering
in Seeded Plot 2
May 2020

PHOTOGRAPH 32
Flagged San Diego Thornmint
Outside of Fenced Areas
May 2020

PHOTOGRAPH 33
Flagged San Diego Thornmint outside of Fenced Areas
May 2020

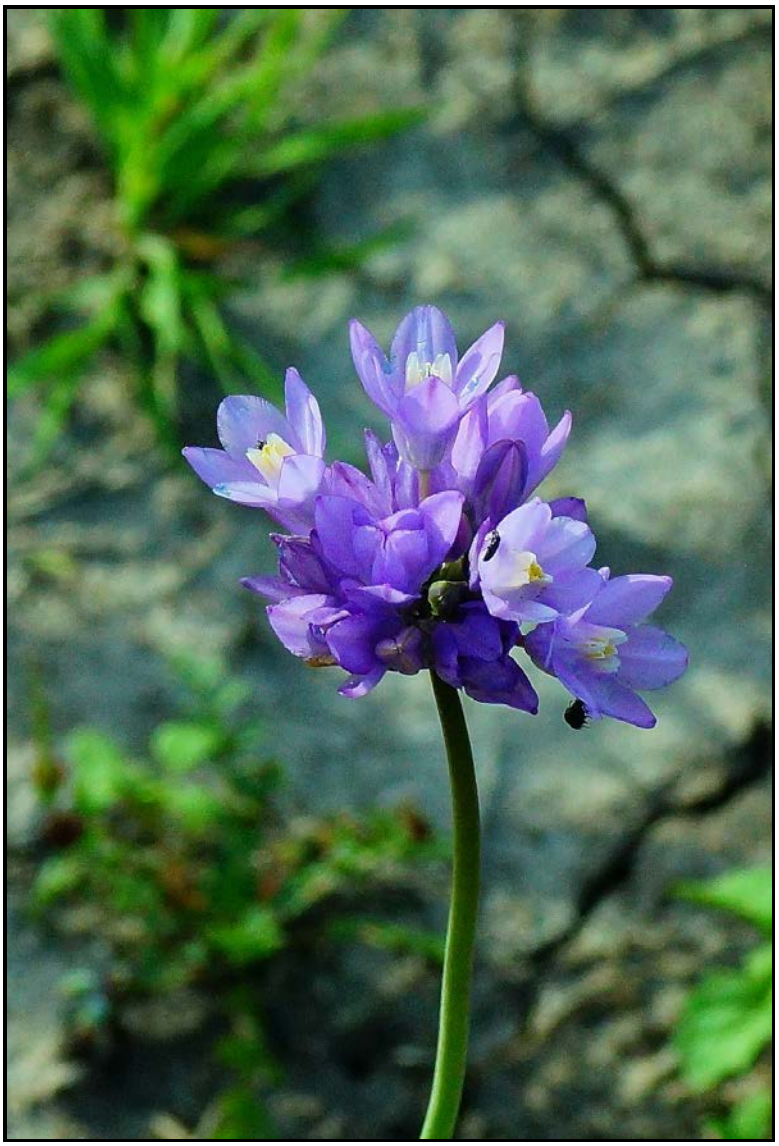
PHOTOGRAPH 34
Close-up of Flowering San Diego Thornmint
May 2020



PHOTOGRAPH 35
Small-flowered Morning Glory Grew in
Both Seeded Plots
January 2020

PHOTOGRAPH 36
California Sun Cup Flowering at the Restoration Site
April 2020

PHOTOGRAPH 37
Parry's Phacelia Flowering at the Restoration Site
May 2020



PHOTOGRAPH 38
Blue Dicks Flowering at the Restoration Site
February 2020

PHOTOGRAPH 39
Charming Centaury Flowering at the Restoration Site
June 2020

PHOTOGRAPH 40
Early Flowering San Diego Thornmint
February 2020

PHOTOGRAPH 41
California Bumblebee Making Focused Visits to
San Diego Thornmint Flowers
June 2020

PHOTOGRAPH 42
California Bumblebee Making Focused Visits to
San Diego Thornmint Flowers
June 2020

PHOTOGRAPH 43
Native Shrubs such as Black Sage are Colonizing
Weeded Areas at the Restoration Site
May 2020

ATTACHMENT 2

Plant Species Observed

Attachment 2 Plant Species Observed		
Scientific Name	Common Name	Origin
ANGIOSPERMS: MONOCOTS		
POACEAE (GRAMINEAE)	**GRASS FAMILY**	
Brachypodium distachyon	purple falsebrome	I
Bromus rubens	red brome	I
Gastridium phleoides [=*ventricosum*]	nit grass	I
Schismus barbatus	Mediterranean schismus	I
ANGIOSPERMS: DICOTS		
ANACARDIACEAE	**SUMAC OR CASHEW FAMILY**	
Malosma laurina	laurel sumac	N
Rhus integrifolia	lemonade berry	N
APIACEAE (UMBELLIFERAE)	**CARROT FAMILY**	
Daucus pusillus	rattlesnake weed	N
ASTERACEAE	**SUNFLOWER FAMILY**	
Artemisia californica	California sagebrush	N
Baccharis sarothroides	broom baccharis	N
Centaurea melitensis	tocalote, Maltese star-thistle	I
Deinandra [=*Hemizonia*] *fasciculata*	fascicled tarweed	N
Eriophyllum confertiflorum var. *confertiflorum*	long-stem golden-yarrow	N
Gutierrezia californica	California matchweed	N
Isocoma menziesii var. *decumbens*	decumbent goldenbush	N
Logfia [=*Filago*] *gallica*	daggerleaf cottonrose	I
Pseudognaphalium [=*Gnaphalium*] *luteoalbum*	everlasting cudweed	I
Sonchus asper ssp. *asper*	prickly sow thistle	I
Sonchus oleraceus	common sow thistle	I
BORAGINACEAE	**BORAGE FAMILY**	
Phacelia parryi	Parry's phacelia	N
BRASSICACEAE (CRUCIFERAE)	**MUSTARD FAMILY**	
Brassica nigra	black mustard	I
Draba cuneifolia	Whitlow-grass	N
Hirschfeldia incana	short-pod mustard	I
Lepidium nitidum	shining peppergrass	N
CACTACEAE	**CACTUS FAMILY**	
Opuntia littoralis	coast prickly-pear, shore cactus	N
CAPRIFOLIACEAE	**HONEYSUCKLE FAMILY**	
Lonicera subspicata	southern honeysuckle	N
CLEOMACEAE	**SPIDERFLOWER FAMILY**	
Peritoma [=*Isomeris*] *arborea*	bladderpod	N
CONVOLVULACEAE	**MORNING-GLORY FAMILY**	
Convolvulus simulans	small-flowered morning-glory	N
CRASSULACEAE	**STONECROP FAMILY**	
Crassula connata	pygmy-weed	N
EUPHORBIACEAE	**SPURGE FAMILY**	
Euphorbia [=*Chamaesyce*] *maculata*	spotted spurge	I
Euphorbia [=*Chamaesyce*] *polycarpa*	smallseed sandmat	N

Attachment 2 Plant Species Observed		
Scientific Name	Common Name	Origin
FABACEAE (LEGUMINOSAE)	**LEGUME FAMILY**	
Acmispon glaber [=*Lotus scoparius*]	deerweed, California broom	N
Astragalus trichopodus var. *lonchus*	ocean locoweed	N
GENTIANACEAE	**GENTIAN FAMILY**	
Zeltnera [=*Centaurium*] *venusta*	California centaury, charming centaury	N
GERANIACEAE	**GERANIUM FAMILY**	
Erodium cicutarium	redstem filaree	I
LAMIACEAE	**MINT FAMILY**	
Acanthomintha ilicifolia	San Diego thornmint	N
Marrubium vulgare	horehound	I
Salvia mellifera	black sage	N
MALVACEAE	**MALLOW FAMILY**	
Malacothamnus fasciculatus	chaparral mallow	N
MYRSINACEAE	**MYRSINE FAMILY**	
Lysimachia [=*Anagallis*] *arvensis*	scarlet pimpernel	I
ONAGRACEAE	**EVENING-PRIMROSE FAMILY**	
Camissoniopsis [=*Camissonia*] *bistorta*	California sun cup	N
POLYGONACEAE	**BUCKWHEAT FAMILY**	
Eriogonum fasciculatum	California buckwheat	N
RESEDACEAE	**MIGNONETTE FAMILY**	
Oligomeris linifolia	narrow-leaf oligomeris	N
ROSACEAE	**ROSE FAMILY**	
Heteromeles arbutifolia	toyon, Christmas berry	N

Notes: Scientific and common names were primarily derived from the Jepson Online Interchange (Jepson Flora Project 2016). In instances where common names were not provided in this resource, common names were obtained from Rebman and Simpson (2014). Additional common names were obtained from the USDA maintained database (USDA 2013) or the *Sunset Western Garden Book* (Brenzel 2001) for ornamental/horticultural plants.

ORIGIN
N = Native to locality
I = Introduced species from outside locality

ATTACHMENT 3

Repeat Photographs–September 2017 and May 2020

PHOTOGRAPH 1
Thornmint Site Prior to Implementation
September 2017

PHOTOGRAPH 2
Same View as Photograph 1
Year 3
May 2020

PHOTOGRAPH 3
Thornmint Site Prior to Implementation
September 2017

PHOTOGRAPH 4
Same View as Photograph 3
Year 3
May 2020

PHOTOGRAPH 5
Thornmint Site Prior to Implementation
September 2017

PHOTOGRAPH 6
Same View as Photograph 5
Year 3
May 2020

PHOTOGRAPH 7
Thornmint Site Prior to Implementation
September 2017

PHOTOGRAPH 8
Same View as Photograph 7
Year 3
May 2020

PHOTOGRAPH 9
Thornmint Site Prior to Implementation
September 2017

PHOTOGRAPH 10
Same View as Photograph 9
Year 3
May 2020

PHOTOGRAPH 11
Thornmint Site Prior to Implementation
September 2017

PHOTOGRAPH 12
Same View as Photograph 11
Year 3
May 2020

PHOTOGRAPH 13
Thornmint Site Prior to Implementation
September 2017

PHOTOGRAPH 14
Same View as Photograph 13
Year 3
May 2020

PHOTOGRAPH 15
Thornmint Site Prior to Implementation
September 2017

PHOTOGRAPH 16
Same View as Photograph 15
Year 3
May 2020

PHOTOGRAPH 17
Thornmint Site Prior to Implementation
September 2017

PHOTOGRAPH 18
Same View as Photograph 17
Year 3
May 2020

PHOTOGRAPH 19
Thornmint Site Prior to Implementation
September 2017

PHOTOGRAPH 20
Same View as Photograph 19
Year 3
May 2020

PHOTOGRAPH 21
Thornmint Site Prior to Implementation
September 2017

PHOTOGRAPH 22
Same View as Photograph 21
Year 3
May 2020